

PWM Step-up DC/DC Controller

NO.EA-064-111123

OUTLINE

The R1210Nxx2C/xx2D Series are CMOS-based PWM step-up DC/DC Converter controllers, with high accuracy, low supply current.

Each of the R1210Nxx2x Series consists of an oscillator, a PWM circuit, a reference voltage unit, an error amplifier, phase compensation circuit, resistors for voltage detection, a chip enable circuit, a controller against drastic load transient and an output voltage detector. A low ripple, high efficiency step-up DC/DC converter can be composed of this IC with only four external components, or an inductor, a diode, a transistor and a capacitor.

The R1210Nxx2x Series can detect drastic change of output voltage with a circuit controller, the load transient response is improved.

Each of the R1210Nxx2x Series has a driver pin, or 'EXT' pin for external transistor. By connecting a power transistor with low ON-resistance to EXT pin, a large current flows through an inductor, thus, large output current can be supplied.

The built-in chip enable circuit can make the standby mode with ultra low quiescent current.

Since the package for these ICs is small SOT-23-5, high density mounting of the ICs on board is possible.

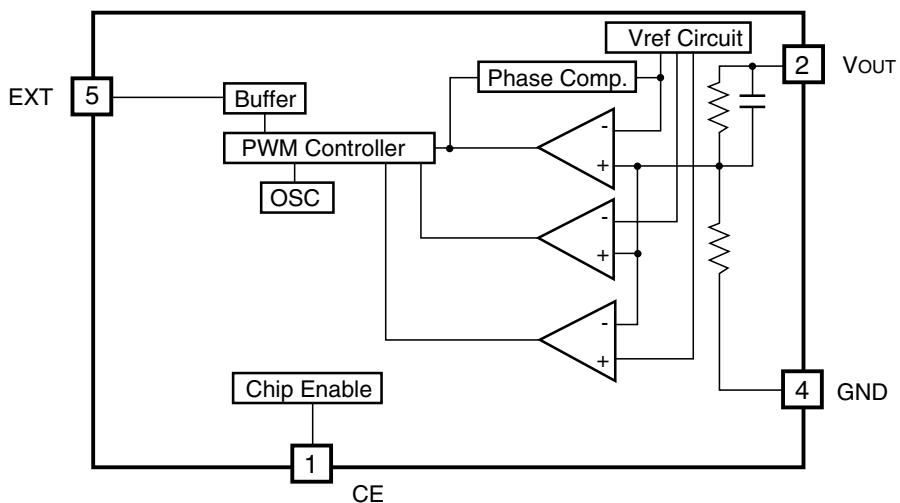
FEATURES

- External Components Only an inductor, a diode, a capacitor, and a transistor
- Standby Current Max. 0.5 μ A
- Low Temperature-Drift Coefficient of Output Voltage Typ. $\pm 100\text{ppm}/^\circ\text{C}$
- Output Voltage Stepwise Setting with a step of 0.1V in the range of 2.2V to 6.0V
- Two choices of Basic Oscillator Frequency 100kHz (xx2C), 180kHz (xx2D)
- Output Voltage Accuracy $\pm 2.5\%$
- Small Package SOT-23-5
- Low Ripple, Low Noise
- Oscillator Start-up Voltage Max. 0.8V

APPLICATIONS

- Power source for battery-powered equipment.
- Power source for portable communication appliances, cameras, VCRs
- Power source for appliances of which require higher voltage than battery voltage.

BLOCK DIAGRAMS



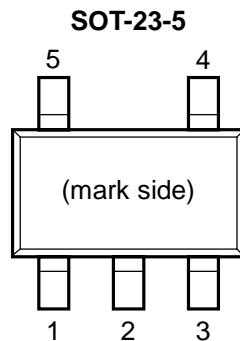
SELECTION GUIDE

In the R1210N Series, the output voltage, the oscillator frequency for the ICs can be selected at the user's request.

The selection can be made by designating the part number as shown below;

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
R1210Nxx2*-TR-FE	SOT-23-5	3,000 pcs	Yes	Yes
xx : Setting Output Voltage(V_{OUT}) Stepwise setting with a step of 0.1V in the range of 2.2V (22) to 6.0V (60)				
* : Designation of Oscillator Frequency C : 100kHz D : 180kHz				

PIN CONFIGURATION



PIN DESCRIPTIONS

Pin No	Symbol	Pin Description
1	CE	Chip Enable Pin
2	V_{OUT}	Pin for Output Voltage
3	NC	No Connection
4	GND	Ground Pin
5	EXT	External Transistor Drive Pin

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating	Unit
V_{OUT}	V_{OUT} Pin Output Voltage	-0.3 to 9.0	V
V_{EXT}	EXT Pin Output Voltage	-0.3 to $V_{OUT}+0.3$	V
V_{CE}	CE Pin Input Voltage	-0.3 to 9.0	V
I_{EXT}	EXT Pin Output Current	± 40	mA
P_D	Power Dissipation	420	mW
T_{opt}	Operating Temperature Range	-40 to +85	°C
T_{stg}	Storage Temperature Range	-55 to +125	°C

*1) For Power Dissipation, please refer to PACKAGE INFORMATION.

ABSOLUTE MAXIMUM RATINGS

Electronic and mechanical stress momentarily exceeded absolute maximum ratings may cause the permanent damages and may degrade the life time and safety for both device and system using the device in the field.

The functional operation at or over these absolute maximum ratings is not assured.

ELECTRICAL CHARACTERISTICS

- R1210Nxx2x

Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit		
V _{OUT}	Output Voltage	V _{IN} =V _{SET} ×0.6, I _{OUT} =1mA	×0.975		×1.025	V		
V _{IN}	Maximum Input Voltage				8	V		
ΔV _{OUT} /ΔT	Step-up Output Voltage Temperature Coefficient	-40°C ≤ Topt ≤ 85°C		±100		ppm/°C		
V _{start}	Start-up Voltage	V _{IN} =0V→2V			0.8	V		
I _{standby}	Supply Current 3(Standby)	V _{OUT} =6.5V, V _{CE} =0V			0.5	μA		
I _{DD1}	Supply Current 1	V _{OUT} = V _{SET} ×0.96 EXT at no load 2.2V ≤ V _{SET} ≤ 2.4V		18	35	μA (xx2C)		
				23	45	μA (xx2D)		
		V _{OUT} = V _{SET} ×0.96 EXT at no load 2.5V ≤ V _{SET} ≤ 3.0V		20	40	μA (xx2C)		
				25	50	μA (xx2D)		
		V _{OUT} = V _{SET} ×0.96 EXT at no load 3.1V ≤ V _{SET} ≤ 3.9V		25	50	μA (xx2C)		
				30	60	μA (xx2D)		
		V _{OUT} = V _{SET} ×0.96 EXT at no load 4.0V ≤ V _{SET} ≤ 4.4V		30	60	μA (xx2C)		
				35	70	μA (xx2D)		
		V _{OUT} = V _{SET} ×0.96 EXT at no load 4.5V ≤ V _{SET} ≤ 4.9V		35	70	μA (xx2C)		
				40	80	μA (xx2D)		
I _{DD2}	Supply Current 2	V _{OUT} =V _{CE} =V _{SET} +0.5		45	90	μA (xx2C)		
				50	100	μA (xx2D)		
				50	100	μA (xx2C)		
				55	110	μA (xx2D)		
				10	15	μA (xx2C)		
				15	22	μA (xx2D)		

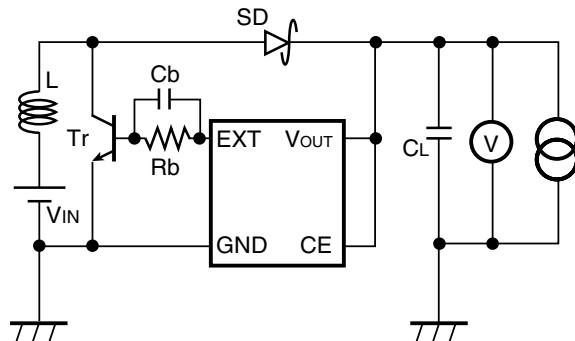
Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
I _{EXTH}	EXT "H" Output Current	2.2V ≤ V _{SET} ≤ 2.5V V _{EXT} =V _{OUT} -0.4V			-1.0	mA
		2.6V ≤ V _{SET} ≤ 3.0V V _{EXT} =V _{OUT} -0.4V			-2.0	mA
		3.1V ≤ V _{SET} ≤ 3.5V V _{EXT} =V _{OUT} -0.4V			-2.5	mA
		3.6V ≤ V _{SET} ≤ 4.0V V _{EXT} =V _{OUT} -0.4V			-3.0	mA
		4.1V ≤ V _{SET} ≤ 4.5V V _{EXT} =V _{OUT} -0.4V			-3.5	mA
		4.6V ≤ V _{SET} ≤ 5.0V V _{EXT} =V _{OUT} -0.4V			-4.0	mA
		5.1V ≤ V _{SET} ≤ 5.5V V _{EXT} =V _{OUT} -0.4V			-4.5	mA
		5.6V ≤ V _{SET} ≤ 6.0V V _{EXT} =V _{OUT} -0.4V			-5.0	mA
fosc	Maximum Oscillator Frequency	V _{OUT} =V _{CE} =V _{SET} ×0.96	80	100	120	kHz (xx2C)
			144	180	216	kHz (xx2D)
Δ fosc/ ΔT	Oscillator Frequency Temperature Coefficient	-40°C ≤ T _{opt} ≤ 85°C		0.5		kHz/°C (xx2C)
				0.6		kHz/°C (xx2D)
Maxdty	Oscillator Maximum Duty Cycle	V _{OUT} =V _{CE} =V _{SET} ×0.96, (V _{EXT} "H" Side)	70	85	97	%
I _{EXTL}	EXT "L" Output Current	2.2V ≤ V _{SET} ≤ 2.5V, V _{EXT} =0.4V	1.0			mA
		2.6V ≤ V _{SET} ≤ 3.0V, V _{EXT} =0.4V	2.0			mA
		3.1V ≤ V _{SET} ≤ 3.5V, V _{EXT} =0.4V	2.5			mA
		3.6V ≤ V _{SET} ≤ 4.0V, V _{EXT} =0.4V	3.0			mA
		4.1V ≤ V _{SET} ≤ 4.5V, V _{EXT} =0.4V	3.5			mA
		4.6V ≤ V _{SET} ≤ 5.0V, V _{EXT} =0.4V	4.0			mA
		5.1V ≤ V _{SET} ≤ 5.5V, V _{EXT} =0.4V	4.5			mA
		5.6V ≤ V _{SET} ≤ 6.0V, V _{EXT} =0.4V	5.0			mA
V _{CEH}	CE "H" Input Voltage	V _{OUT} =V _{SET} ×0.96	0.9			V
V _{CEL}	CE "L" Input Voltage	V _{OUT} =V _{SET} ×0.96			0.3	V
I _{CEH}	CE "H" Input Current	V _{OUT} =V _{CE} =6.5V	-0.1	0.0	0.1	μA
I _{CEL}	CE "L" Input Current	V _{IN} =6.5V, V _{CE} =0V	-0.1	0.0	0.1	μA

*Note: V_{SET} means setting Output Voltage.

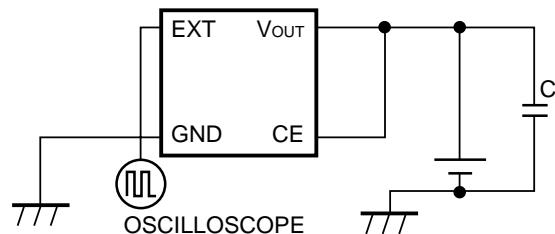
RECOMMENDED OPERATING CONDITIONS (ELECTRICAL CHARACTERISTICS)

All of electronic equipment should be designed that the mounted semiconductor devices operate within the recommended operating conditions. The semiconductor devices cannot operate normally over the recommended operating conditions, even if when they are used over such conditions by momentary electronic noise or surge. And the semiconductor devices may receive serious damage when they continue to operate over the recommended operating conditions.

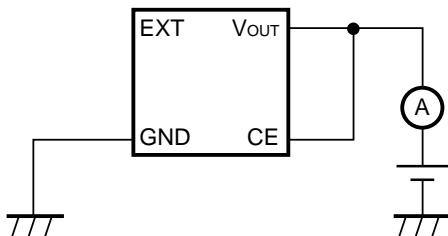
TEST CIRCUITS



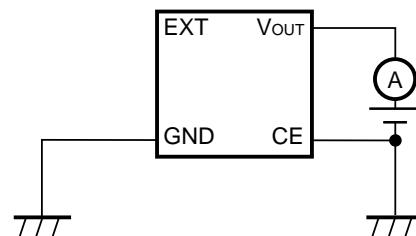
Test Circuit 1



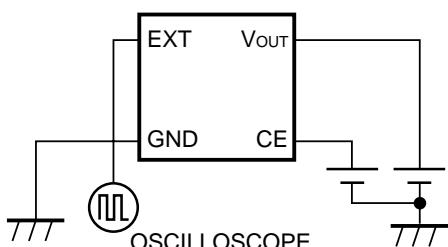
Test Circuit 2



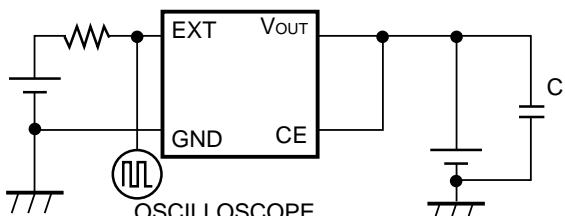
Test Circuit 3



Test Circuit 4



Test Circuit 5



Test Circuit 6

Inductor (L) : $27\mu\text{H}$ (Sumida Electric Co., Ltd. CD104)

Diode (SD) : RB491D (Rohm, Schottky Type)

Capacitor (CL) : $47\mu\text{F} \times 2$ (Tantalum Type)

Transistor (Tr) : 2SD1628G

Base Resistor (Rb) : 300Ω

Base Capacitor (Cb) : $0.01\mu\text{F}$ (Ceramic Type)

The typical characteristics were obtained by use of these test circuits.

Test Circuit 1 : Typical Characteristics 1) 2) 3) 4) 5)

Test Circuit 2 : Typical Characteristics 9) 10)

Test Circuit 3 : Typical Characteristics 6) 7)

Test Circuit 4 : Typical Characteristics 8)

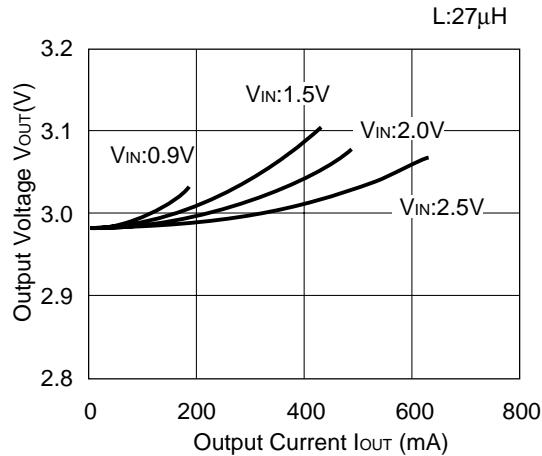
Test Circuit 5 : Typical Characteristics 11)

Test Circuit 6 : Typical Characteristics 12)

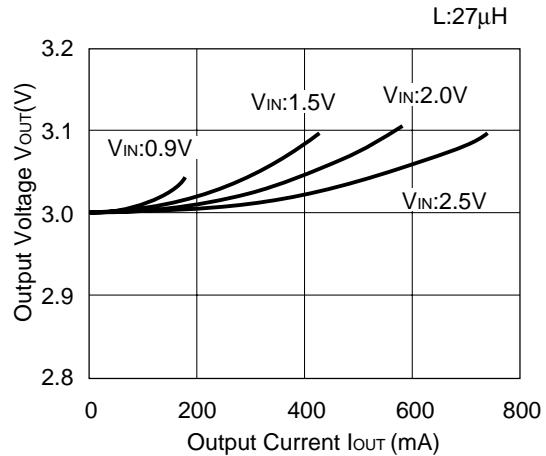
TYPICAL CHARACTERISTICS

1) Output Voltage vs. Output Current

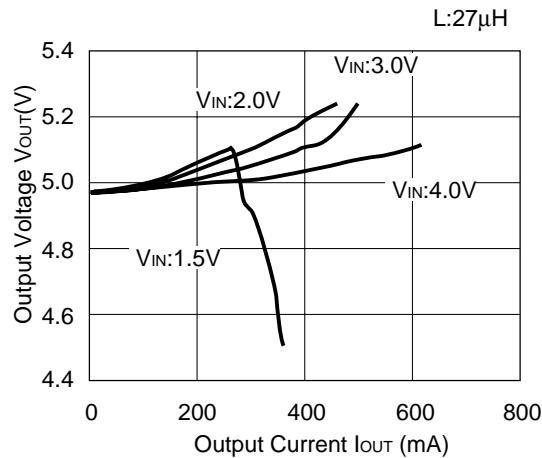
R1210N302C



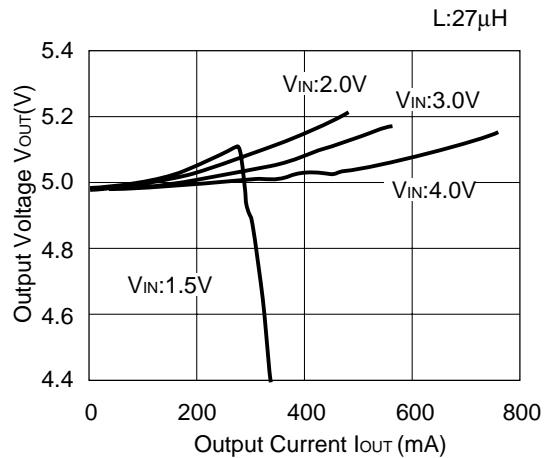
R1210N302D



R1210N502C

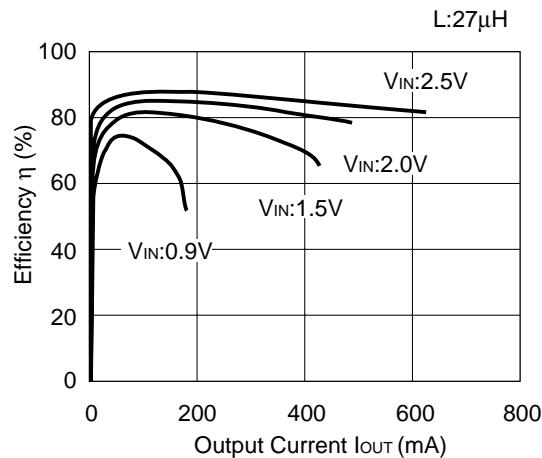


R1210N502D

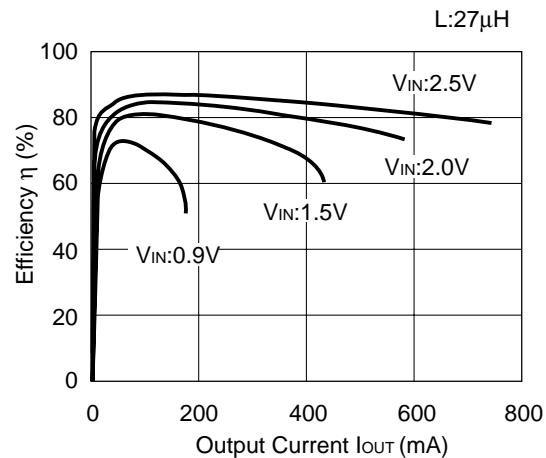


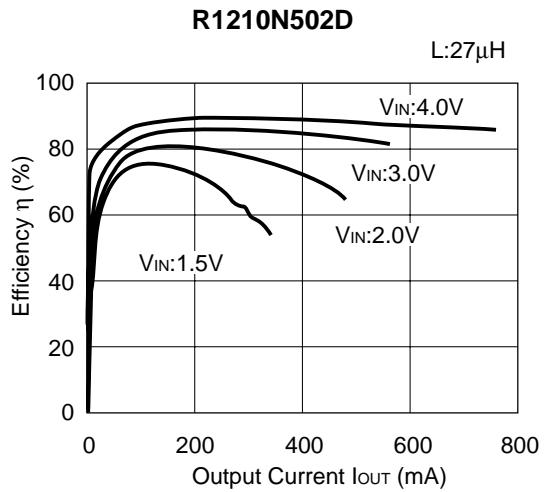
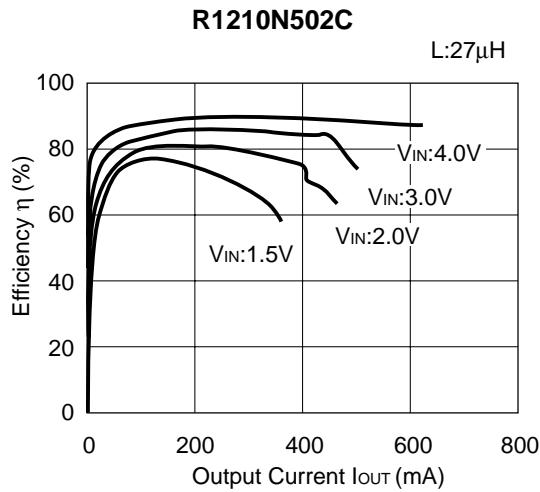
2) Efficiency vs. Output Current

R1210N302C

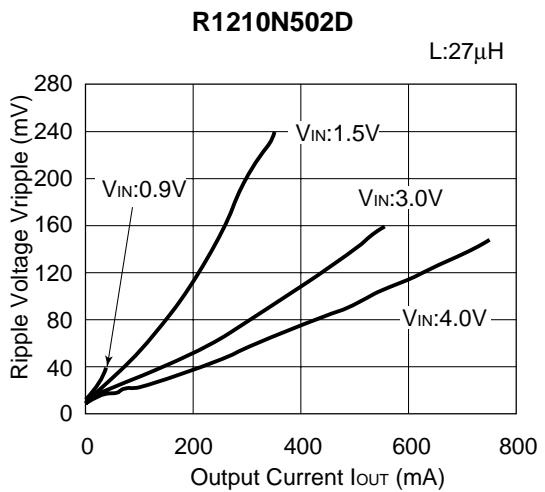
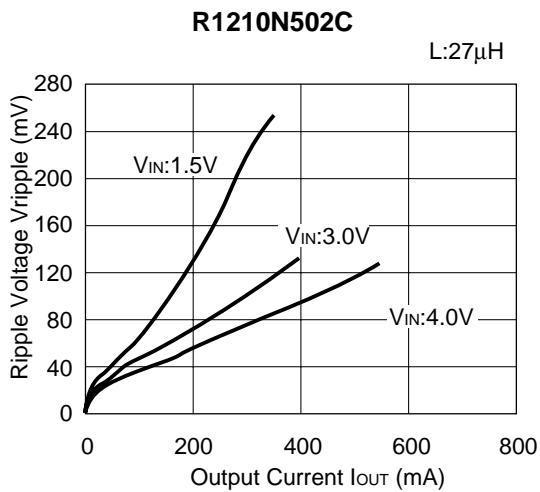
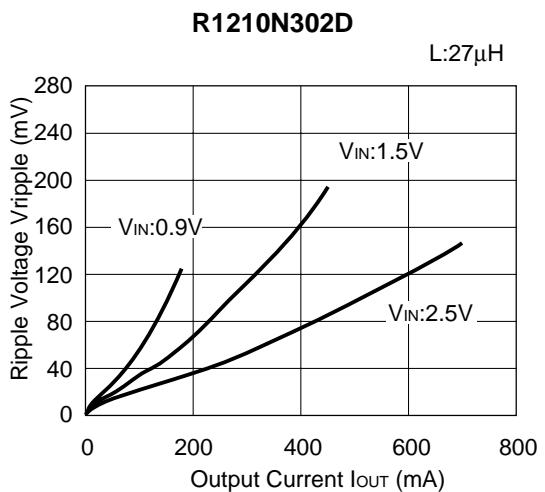
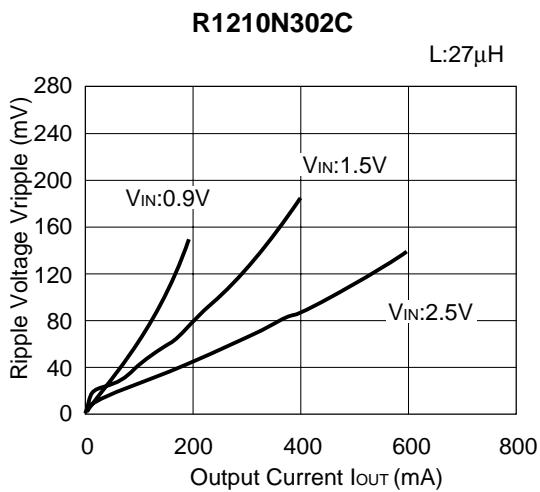


R1210N302D



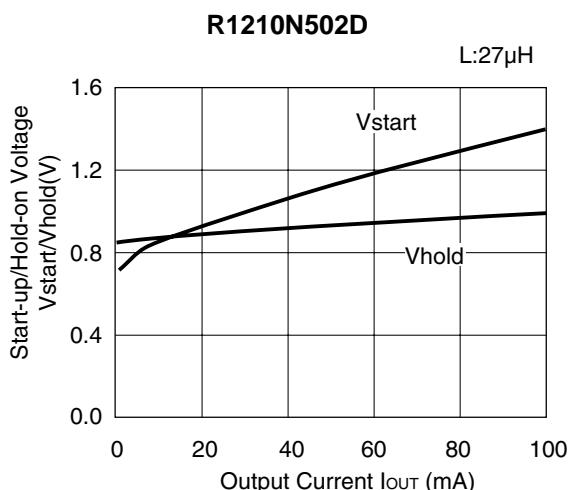
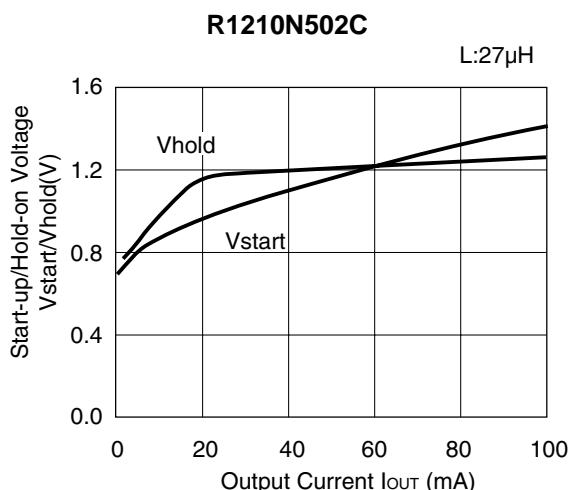
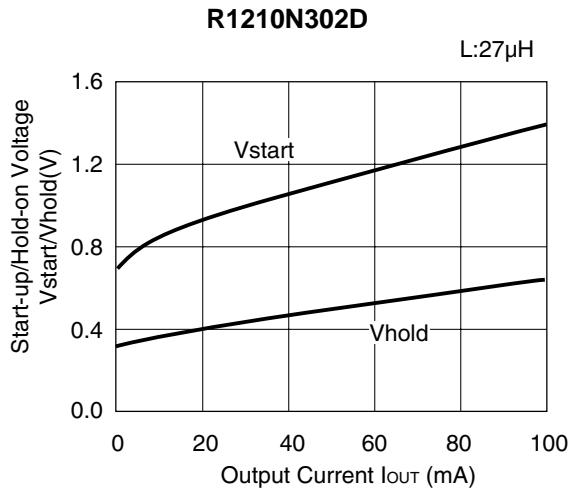
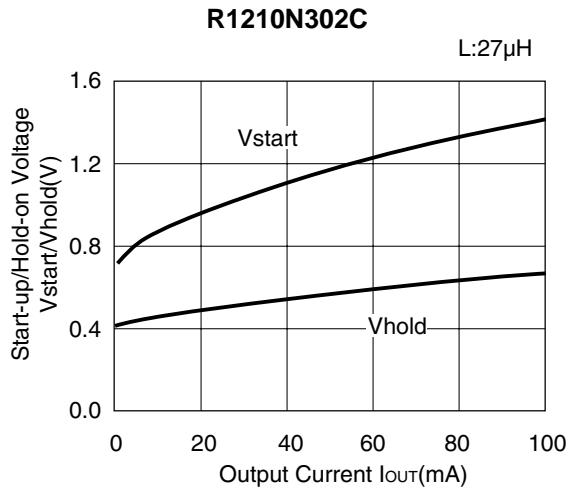


3) Ripple Voltage vs. Output Current

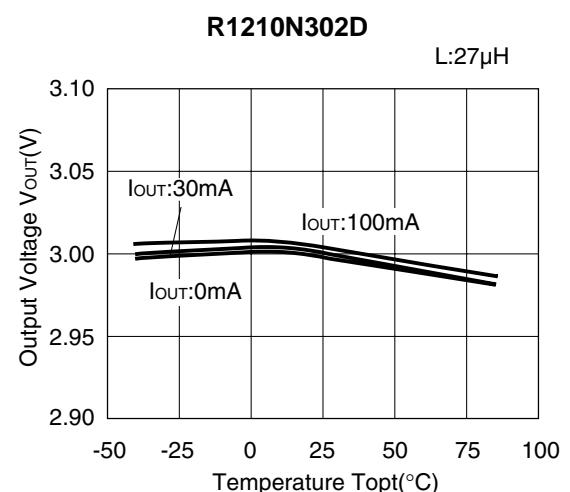
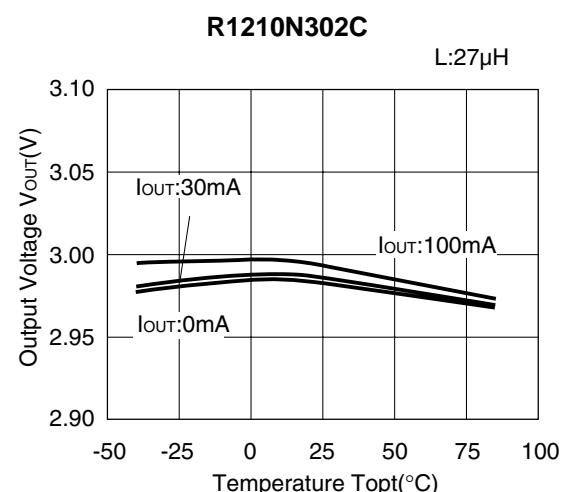


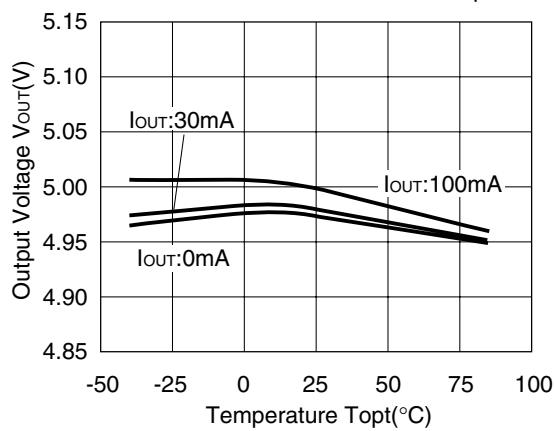
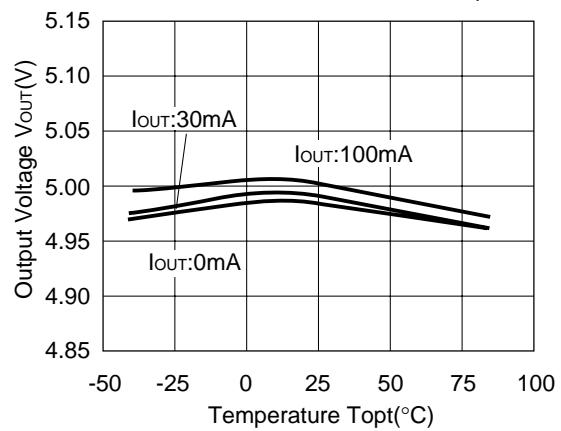
R1210Nxx2x

4) Start-up Voltage/ Hold-on Voltage vs. Output Current (Topt=25°C)

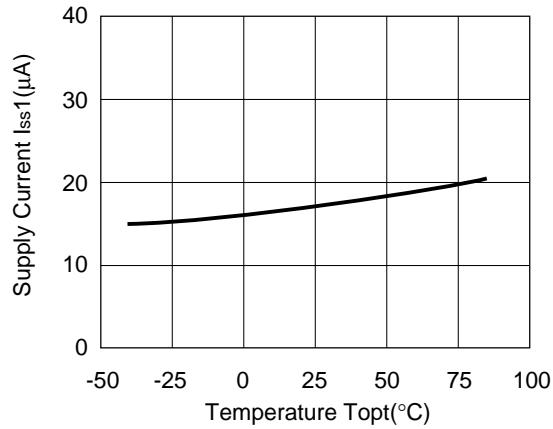
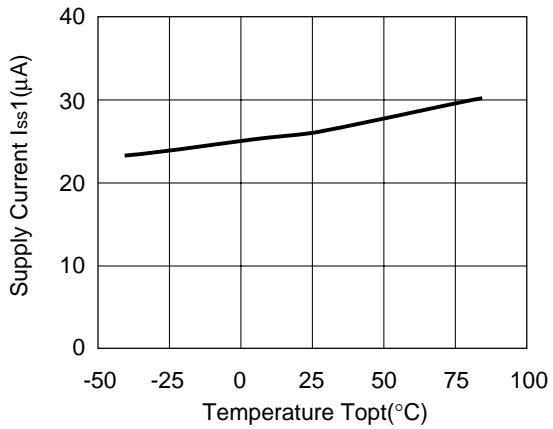
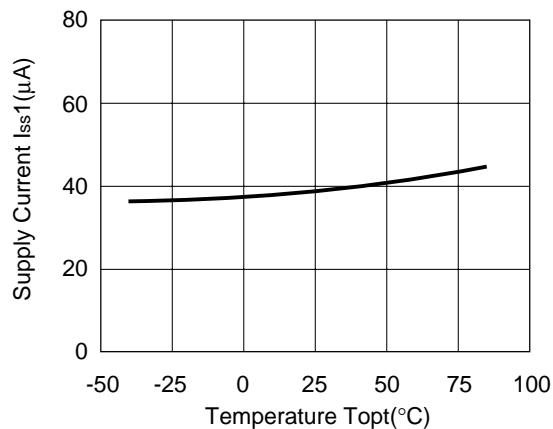
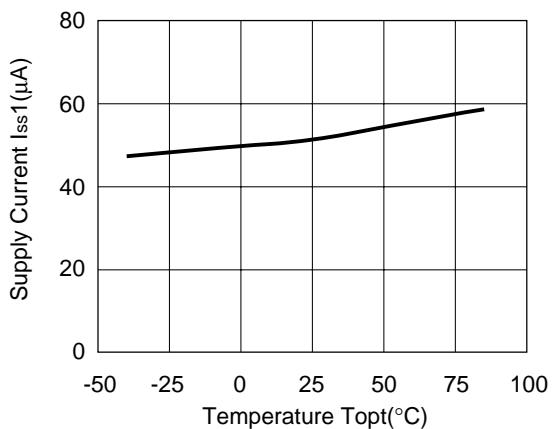


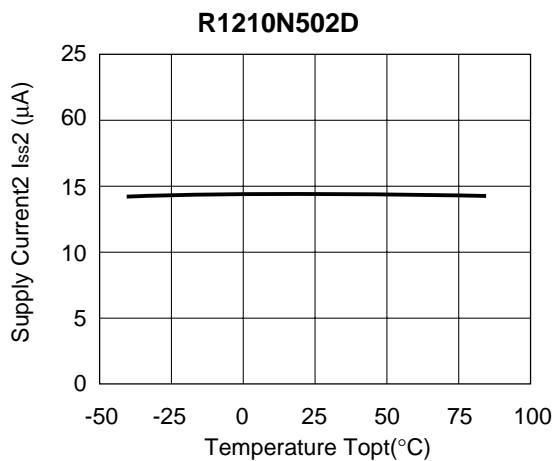
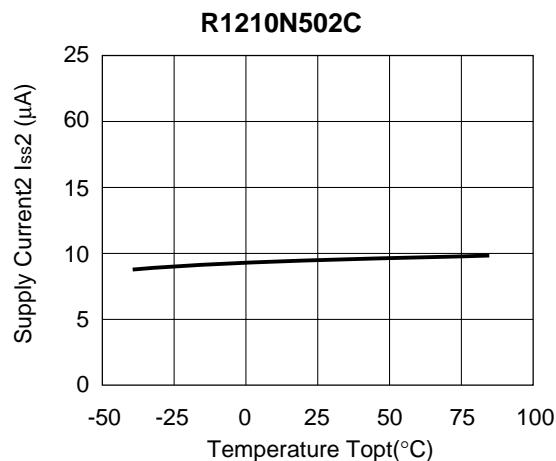
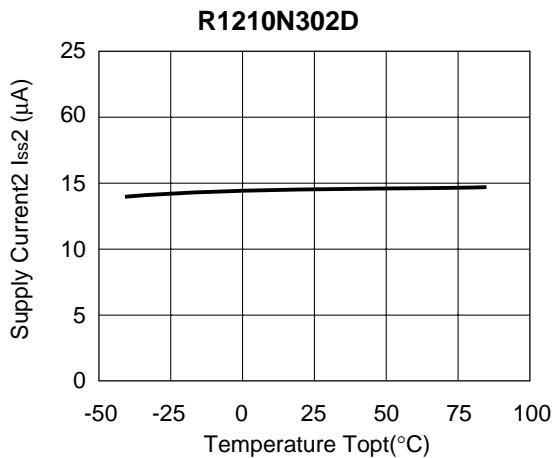
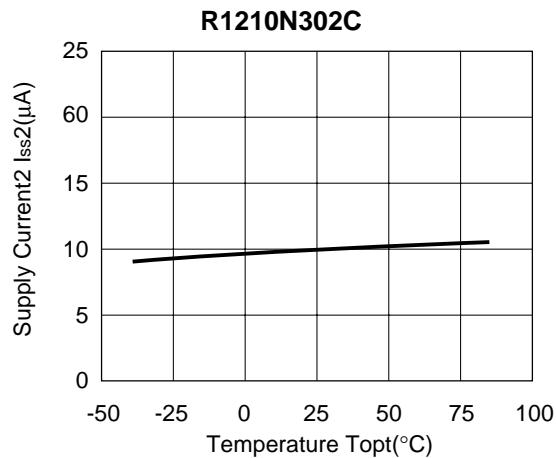
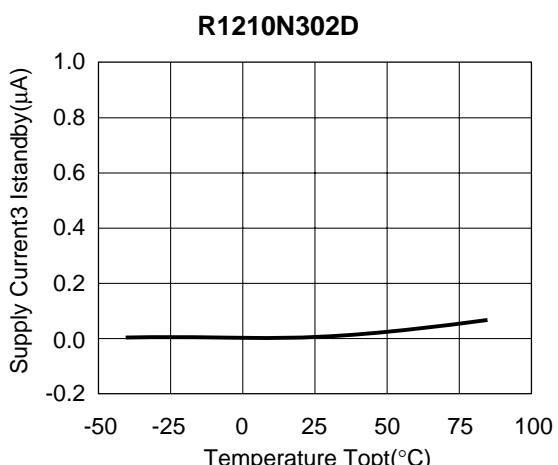
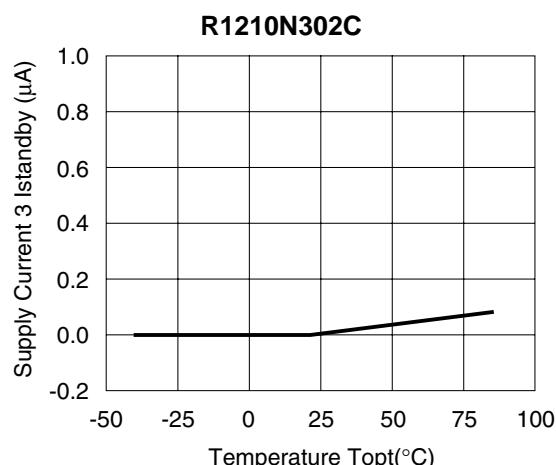
5) Output Voltage vs. Temperature

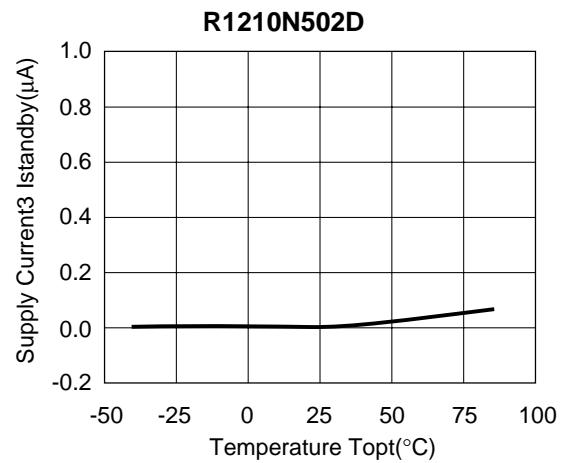
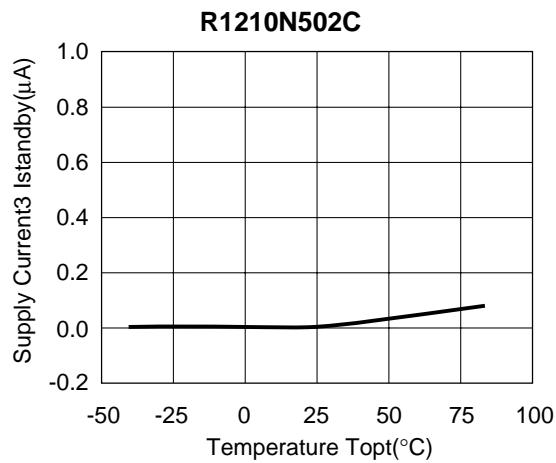


R1210N502CL:27 μ H**R1210N502D**L:27 μ H

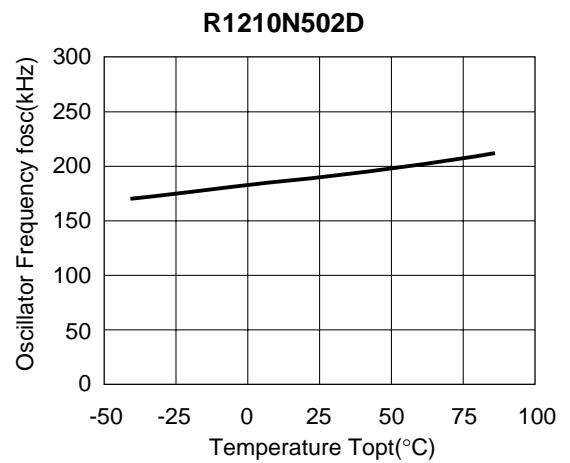
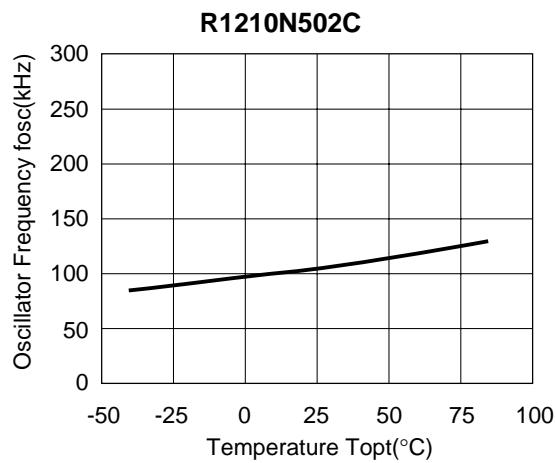
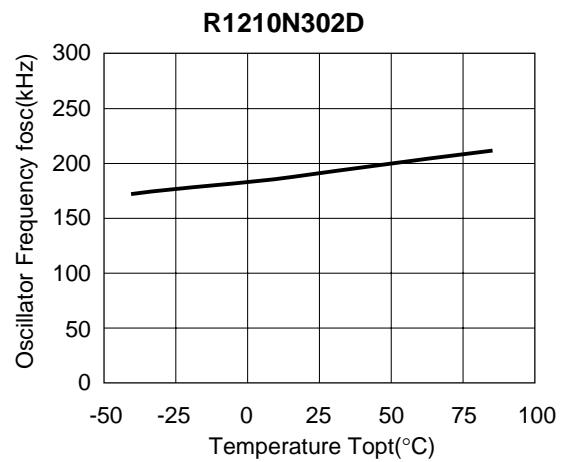
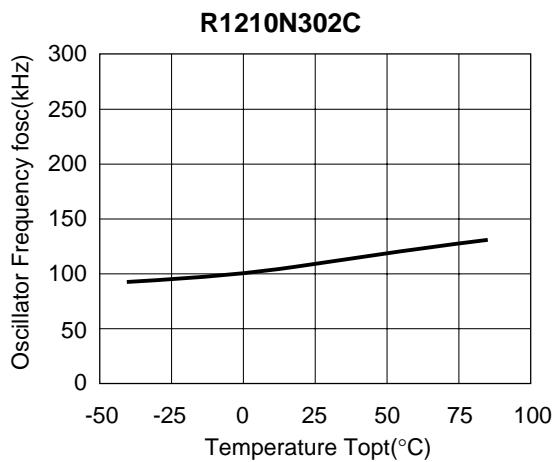
6) Supply Current 1 vs. Temperature

R1210N302C**R1210N302D****R1210N502C****R1210N502D**

7) Supply Current 2 vs. Temperature**8) Supply Current 3 vs. Temperature**

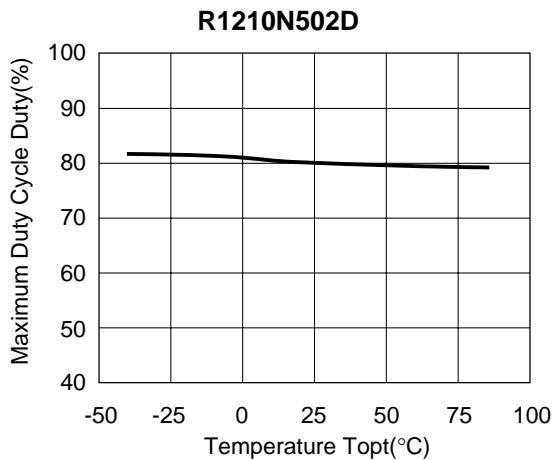
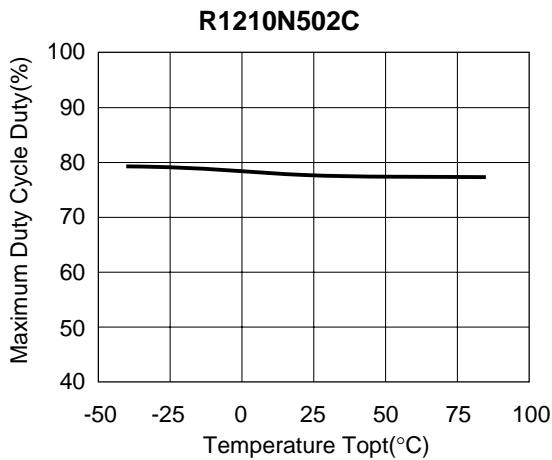
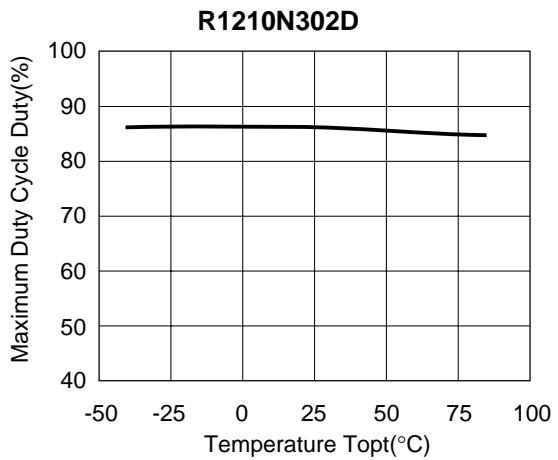
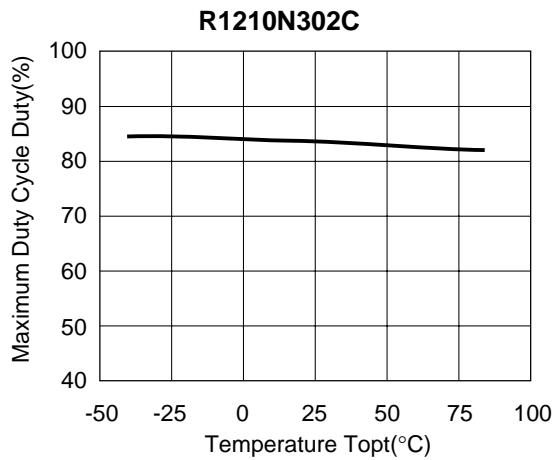


9) Oscillator Frequency vs. Temperature

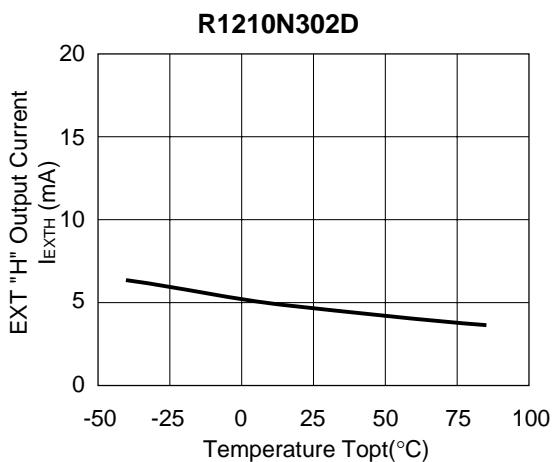
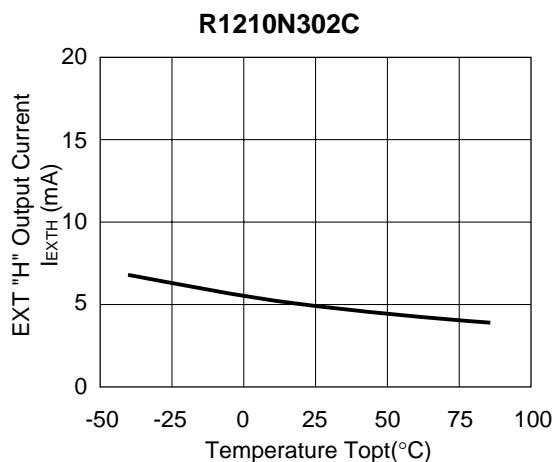


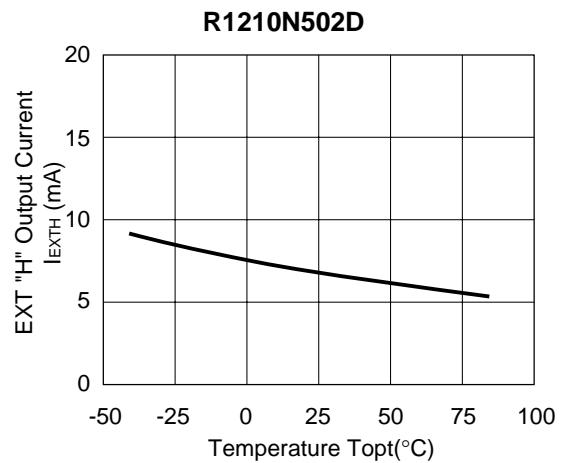
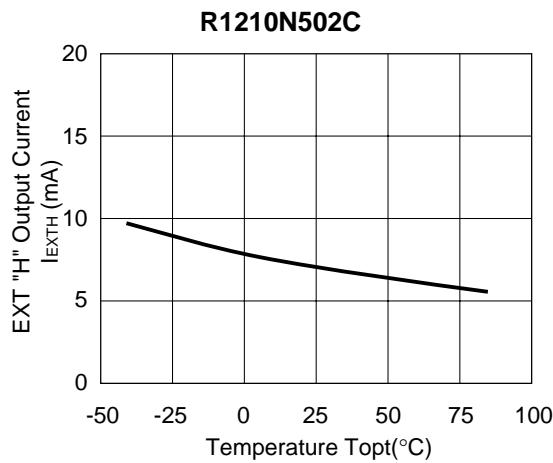
R1210Nxx2x

10) Maximum Duty Cycle vs. Temperature

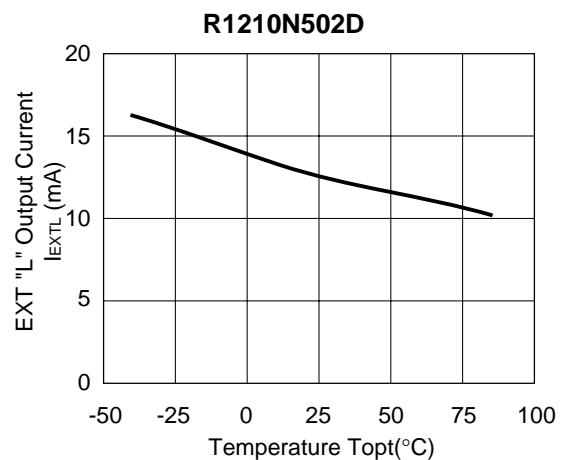
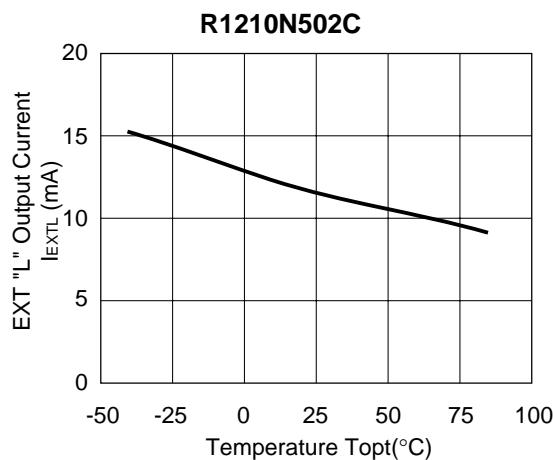
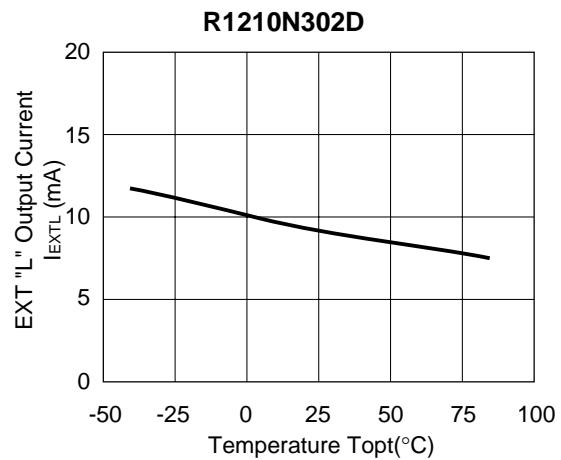
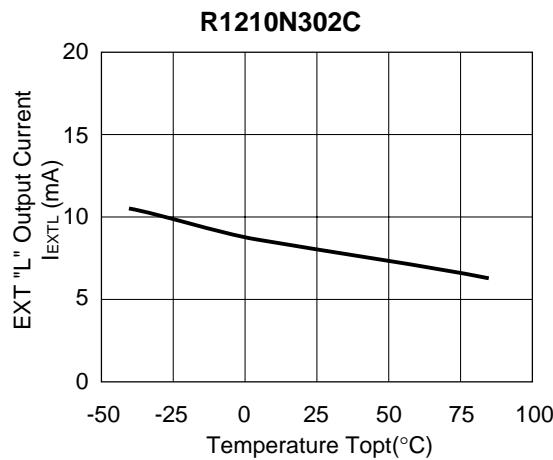


11) EXT "H" Output Current vs. Temperature



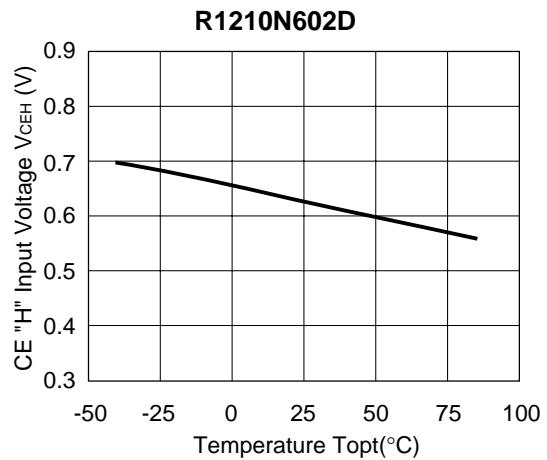
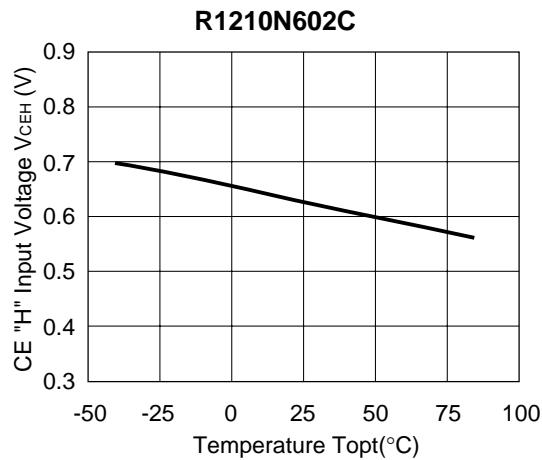


12) EXT "L" Output Current vs. Temperature

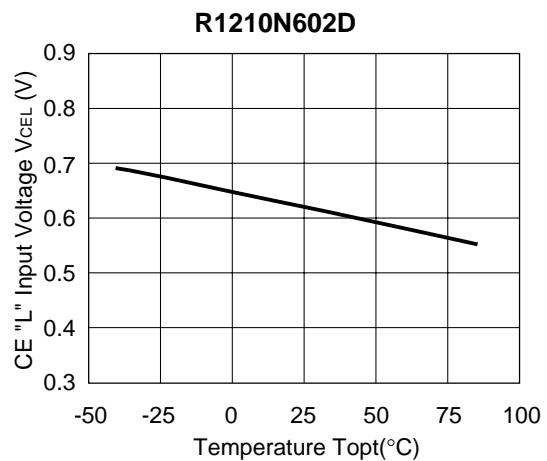
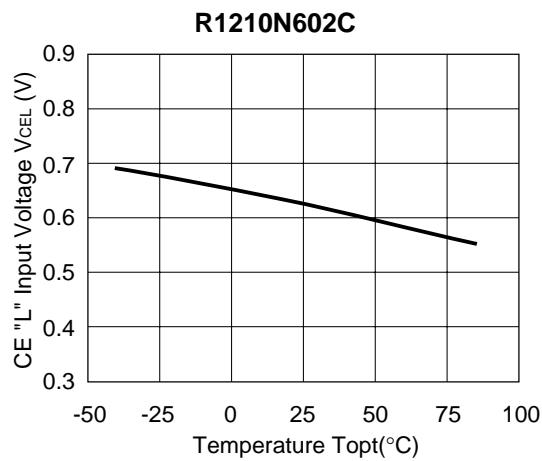


R1210Nxx2x

13) CE "H" Input Voltage vs. Temperature

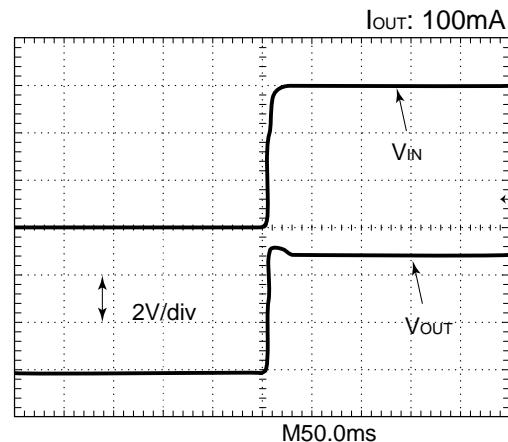
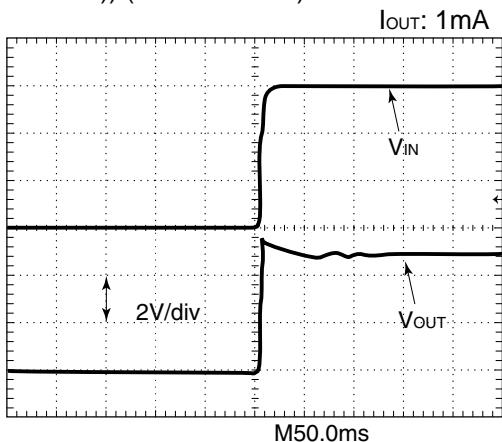


14) CE "L" Input Voltage vs. Temperature

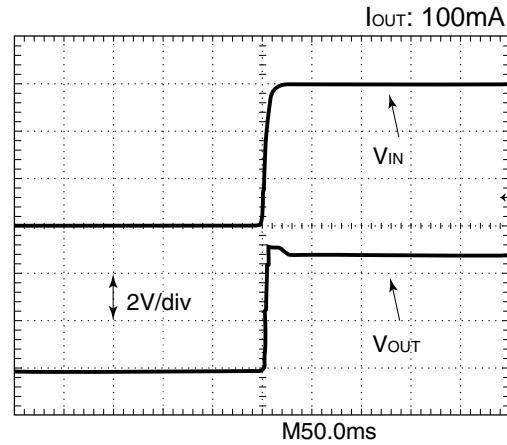
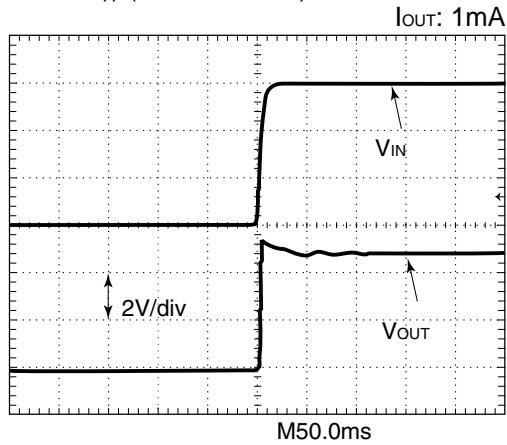


15) Output Waveform at Power-on (T_{opt}=25°C)

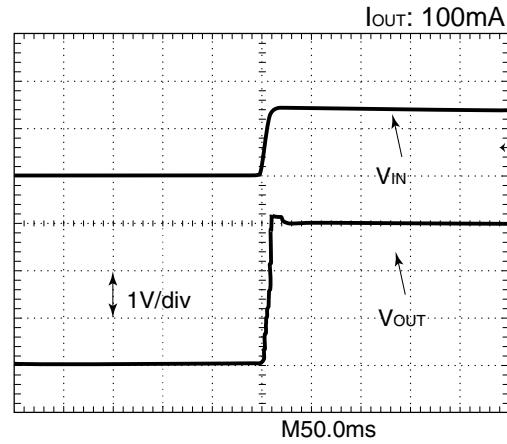
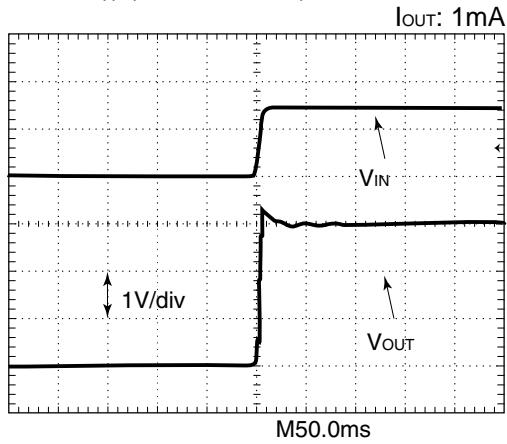
((R1210N502C)) (V_{IN}: 0V→3.0V)



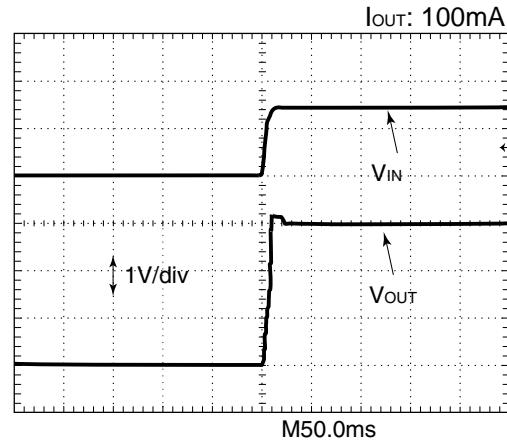
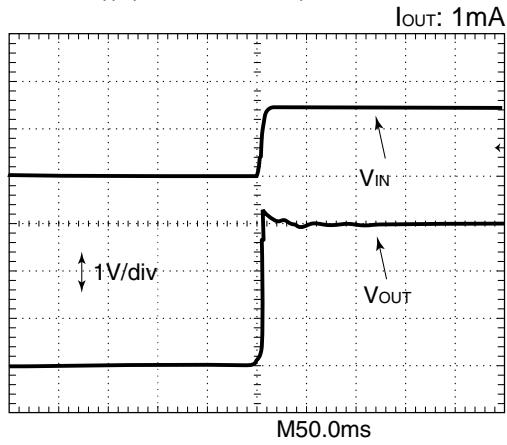
((R1210N502D)) (V_{IN} : 0V→3.0V)



((R1210N302C)) (V_{IN} : 0V→1.5V)



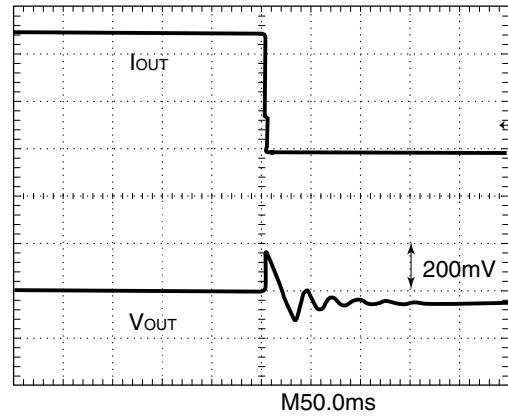
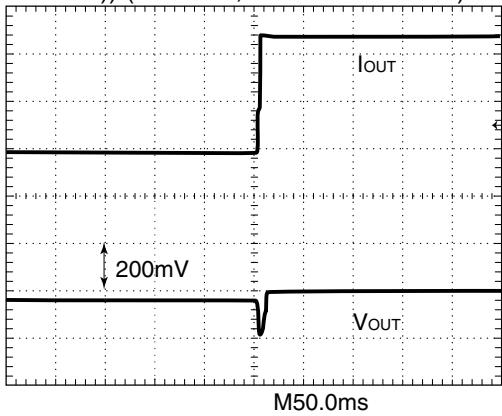
((R1210N302D)) (V_{IN} : 0V→1.5V)



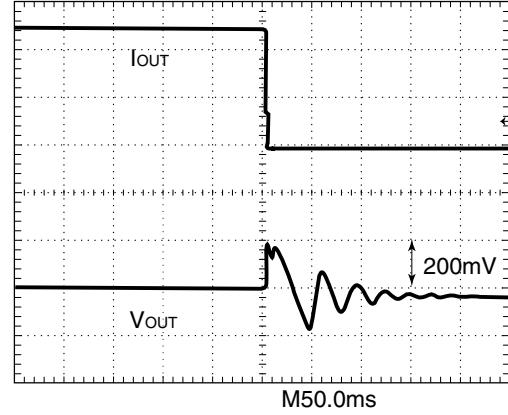
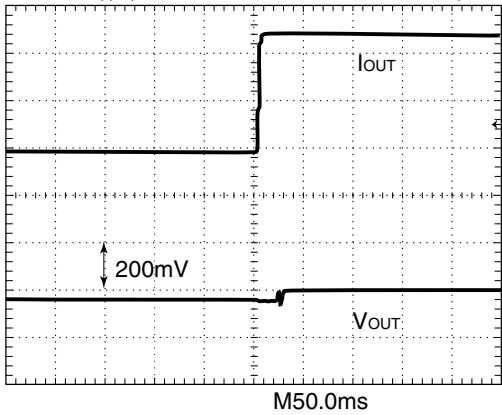
R1210Nxx2x

16) Load Transient Response (Topt=25°C)

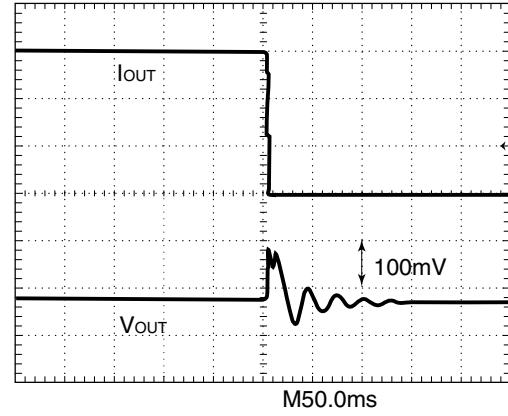
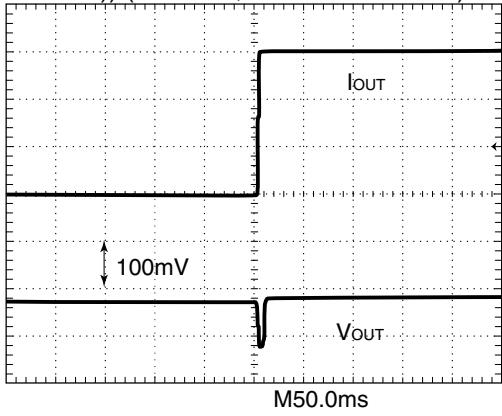
((R1210N502C)) (V_{IN} : 3.0V, I_{OUT} : 1mA \rightarrow 200mA)



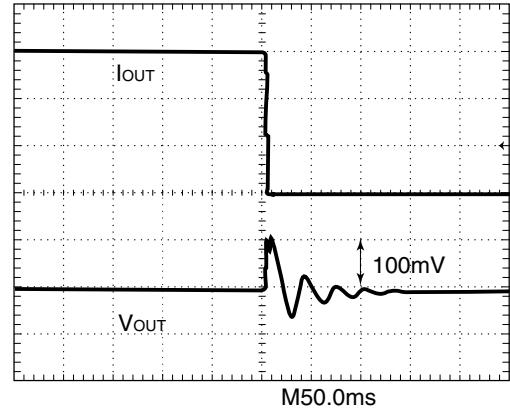
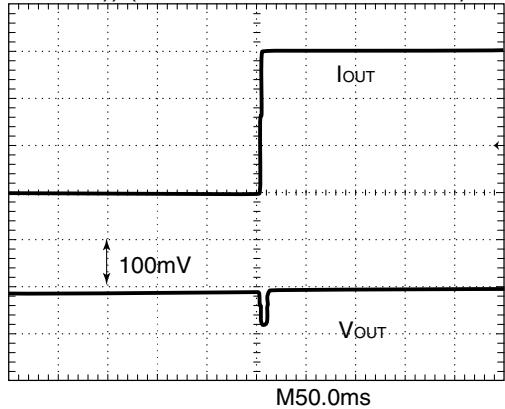
((R1210N502D)) (V_{IN} : 3.0V, I_{OUT} : 1mA \rightarrow 200mA)



((R1210N302C)) (V_{IN} : 1.5V, I_{OUT} : 1mA \rightarrow 100mA)



((R1210N302D)) (V_{IN} : 1.5V, I_{OUT} : 1mA → 100mA)





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RICOH COMPANY, LTD.
Electronic Devices Company

● **Higashi-Shinagawa Office (International Sales)**
3-32-3, Higashi-Shinagawa, Shinagawa-ku, Tokyo 140-8655, Japan
Phone: +81-3-5479-2857 Fax: +81-3-5479-0502

RICOH EUROPE (NETHERLANDS) B.V.
● **Semiconductor Support Centre**
Prof. W.H.Keesomlaan 1, 1183 DL Amstelveen, The Netherlands
P.O.Box 114, 1180 AC Amstelveen
Phone: +31-20-5474-309 Fax: +31-20-5474-791

RICOH ELECTRONIC DEVICES KOREA Co., Ltd.
11 floor, Haesung 1 building, 942, Daechidong, Gangnamgu, Seoul, Korea
Phone: +82-2-2135-5700 Fax: +82-2-2135-5705

RICOH ELECTRONIC DEVICES SHANGHAI Co., Ltd.
Room403, No.2 Building, 690#B1 Bo Road, Pu Dong New district, Shanghai 201203,
People's Republic of China
Phone: +86-21-5027-3200 Fax: +86-21-5027-3299

RICOH COMPANY, LTD.
Electronic Devices Company
● **Taipei office**
Room109, 10F-1, No.51, Hengyang Rd., Taipei City, Taiwan (R.O.C.)
Phone: +886-2-2313-1621/1622 Fax: +886-2-2313-1623



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